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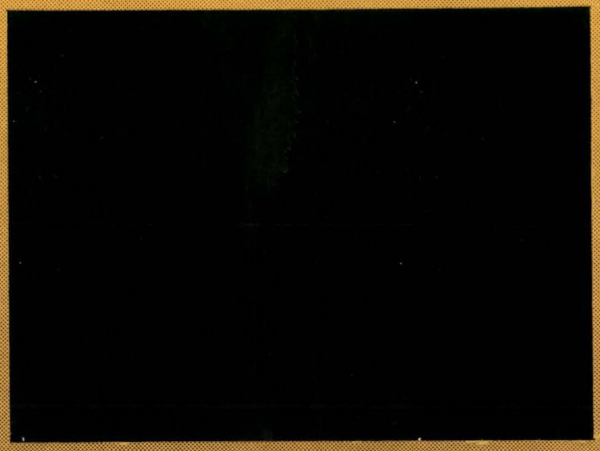

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EFFECTS OF APPLICATION RATE AND TIMING OF ETHEPHON TREATMENTS ON ABSCISSION OF PONDEROSA PINE DWARF MISTLETOE 4 YEARS FOLLOWING TREATMENT

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ABSTRACT

Evaluation of field tests of the plant growth regulator, ethephon, has shown that significant abscission of dwarf mistletoe shoots occurs within a few weeks after application. Tests conducted in the Black Forest north of Colorado Springs, Colorado in 1988 on ponderosa pine dwarf mistletoe, Arceuthobium vaginatum ssp. cryptopodum, showed abscission rates of 73 to 98 percent. Applications were made in mid-June, mid-July and mid-August at rates of 2200 and 2700 ppm of ethephon in water with a spreader-sticker.

Examination of trees 4 years following treatment showed development of immature shoots on all treatments and some development of mature shoots with fruits. It is also interesting to note that 32 percent of the original branch infections have died as a result of breakage, girdling by rodents, and other natural agents during this time.

INTRODUCTION

Several studies to evaluate the effectiveness of the plant growth regulator ethephon (2-chloroethylphosphonic acid) in causing the abscission of dwarf mistletoe shoots have been conducted in the past few years (see references). In the Rocky Mountain Region, tests on ponderosa pine dwarf mistletoe, Arceuthobium vaginatum ssp. cryptopodum, were begun in 1988. During June, July and August 1988, ethephon was applied by hydraulic sprayer at rates of 0 (control), 2200 and 2700 ppm with nonionic surfactant (Ortho X-77 spreader) in water to infected ponderosa pine in the Black Forest north of Colorado Springs, Colorado. Thirty non-systemic female infections were randomly selected in the lower crowns of pines for each treatment, usually three infections per tree. The number of shoots on each infection was determined and recorded prior to treatment and each year thereafter. Details of the study and subsequent yearly observations are contained in the reports by Johnson, Hildebrand and Hawksworth, 1989; Johnson and Hildebrand, 1990; and Johnson, 1991.

This report summarizes data collected since the inception of the study in 1988.

METHODS AND MATERIALS

Direct observations of previously tagged infections on branches were made in July each year. If branches or infections had died since the last observation, this was noted. The presence of shoots and those with fruits was recorded. Results for the two application rates were compared to the controls and to each other.

RESULTS AND DISCUSSION

Data for each application date within treatments (June, July and August) were combined since there was little difference in results between treatment dates (Johnson and Hildebrand, 1989b). Since seed dispersal commenced by early August, treatment by mid-July was effective in limiting spread of the disease in the first year. Loss of infected branches to mortality caused by breakage, girdling by rodents, and other natural agents was observed since the inception of the study and amounted to 32 percent (Table 1). An adjustment of sample size was made accordingly.

One month after treatment in 1988, frequency of infections with shoots was 94 percent in the controls, and significantly less in ethephon-treated infections. For infections treated with 2200 and 2700 ppm ethephon, frequencies ranged from 44 to 28 percent, respectively (Table 2). Only one infection out of 270 tagged for observation had fruits.

Development of small immature shoots was noted in all treatments by August of the first year. One year following treatment, frequency of infections with shoots was 80 percent in the controls, and significantly less for ethephon-treated infections: 52-67 percent. Frequency of infections with fruits was 44 percent in the controls and significantly less in ethephon-treated infections: 1-6 percent (Table 2). Results were not significantly different between the two ethephon application rates after the first year.

In 1989, natural abscission and insect activity caused the reduction in numbers of shoots observed in the controls. In 1990, 2 years after treatment, dwarf mistletoe shoot development was depressed uniformly over all treatments, apparently due to drought, and there was no significant difference in numbers of infections with shoots or with fruits for any treatment (Table 2). Of a total of 215 infection sites observed, only 3 had mature shoots with fruits and the number of individual shoots was sparse.

In 1991, we observed a continued loss of infections to natural causes in all treatments (Table 1), which has resulted in a 32 percent reduction in live infections since 1988. No differences in numbers of shoots or mature shoots with fruits were observed 3 years after treatment (Table 2).

In 1992, development of mature shoots with fruits was apparent in all treatments. Shoots were noted on 40-51 percent of the remaining live branches (Table 2). Fruits were observed on a small number of shoots ranging from 2-6 percent (Table 2).

Ethephon does not appear to provide long-term control of dwarf mistletoe, but by causing shoot abscission, it can substantially reduce the spread of the parasite. To our knowledge, ethephon has no systemic action and only external portions of dwarf mistletoe plants are affected. These data seem to support this. Regrowth of treated infections has resulted in the production of mature shoots and fruits the fourth year after treatment. Additional applications of ethephon will need to be made to protect mistletoe-free understory pines unless silvicultural treatments are used to remove infected trees. The most promising use of the chemical is in limited situations where high value infected trees need to be retained for aesthetic reasons and it is desirable to prevent infection of planted trees or natural regeneration of the same species.

Ethephon is available under the trade name Florel R through the following distributors: Monterey Chemical, Fresno, California and Charles H. Lilly Company, Portland, Oregon.

Table 1. Number of dwarf mistletoe infection sites remaining on live ponderosa pine branches treated with ethephon and observed over a 4-year period, Black Forest, Colorado.

Treatment	Year (Number of Live Branches Remaining) 1988	1989	1990	1991	1992
Control 0 ppm	90	81	71	61	58
Ethephon 2200 ppm	90	78	72	62	63
Ethephon 2700 ppm	90	81	72	66	63
Totals	270	240	215	189	184

Table 2. Percent changes in dwarf mistletoe infections with shoots and with fruits observed over a 4-year period on ponderosa pines treated with ethephon, Black Forest, Colorado.

Treatment	Year and Percent of Infections with Shoots and with Fruits 1/ 1988 S	1989 S F	1990 S F	1991 S F	1992 S F
Control 0 ppm	94.0	80.2/44.4	16.9/0	16.4/0	43.1/1.7
Ethephon 2200 ppm	44.4	66.6/ 6.4	16.7/1.4	20.9/1.6	50.8/4.8
Ethephon 2700 ppm	27.8	51.8/ 1.2	15.3/2.8	15.1/1.5	39.7/6.3

1/ S = Shoots; F = Fruits.

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